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Factsheet

MAXIMIZING CARCASS INDEX: PRACTICAL CONSIDERATIONS

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Since 1969 several revisions have been made to the grading system in order to reflect the improvements in carcass quality that have occurred as a result of changes in management, nutrition and genetics. The most recent change occurred in 1986 when the grading system was modified to take into account muscle depth. Muscle depth is now included in the grading formula because it improves the accuracy with which the lean content of the carcass can be estimated.

Carcasses are now evaluated on the basis of their weight and their estimated lean yield which is determined by a fibre-optic probe. The probe is inserted in the carcass 7 cm off the midline between the third and fourth last ribs, and gives off a beam of light which reflects differently when travelling through fat and muscle. Lean yield of the carcass is estimated from a formula using the measurements of backfat depth and muscle depth. The Destron probe estimates lean yield by the following formula: [55.07 - 10.377 x backfat depth] + [0.052 x muscle depth]. Based on its lean yield, the carcass is classified in a yield class. The yield class and the weight of the carcass are used to determine carcass index (Table 1):

FACTORS AFFECTING CARCASS INDEX

As a result of the recent changes to the grading system, carcass index is now determined by three factors:

1. carcass weight
2. backfat thickness
3. muscle (lean) depth

Muscle depth, however, has a relatively minor influence on carcass index. Its importance is approximately 1/20th that of backfat depth.

Carcass weight

Carcasses in the weight range of 75-79 kg receive the highest grades, although weights in the range of 70-74 kg and 80-84 kg will also result in acceptable indexes. Above 84 kg, indexes drop and below 70 kg they decrease markedly.

Table 1. **THE CANADIAN HOG CARCASS GRADING/SETTLEMENT SYSTEM**
SYSTÈME CANDIEN DE CLASSEMENT DES CARCASSES DE PORC

Weight Class/ Catégorie de poids		1	2	3	4	5	6	7	8	9	10
		40-59.99 kg	60-64.99 kg	65-69.99 kg	70-74.99 kg	75-79.99 kg	80-84.99 kg	85-89.99 kg	90-94.99 kg	95-99.99 kg	100+
Yield Class/ Cat. du rendement	Estimated Lean Yield/ Rendement approximatif en viande (%)										
1	≥ 53.6	80	100	106	112	114	113	111	108	100	81
2	52.8 - 53.59	80	98	105	111	113	112	109	107	98	81
3	52.0 - 52.79	80	97	103	109	112	111	108	105	97	81
4	51.2 - 51.99	80	95	101	107	110	109	107	103	95	81
5	50.4 - 51.19	80	93	100	106	108	107	106	102	92	81
6	49.6 - 50.39	80	92	98	104	107	106	104	100	90	81
7	48.8 - 49.59	80	90	96	102	105	104	102	97	87	81
8	48.0 - 48.79	80	89	95	101	103	102	101	95	83	81
9	47.2 - 47.99	80	88	93	99	102	101	99	92	82	81
10	46.4 - 47.19	80	87	91	97	100	99	97	90	82	81
11	45.6 - 46.39	80	86	89	96	98	97	96	88	82	81
12	44.8 - 45.59	80	85	88	94	97	96	94	85	82	81
13	44.0 - 44.79	80	83	87	92	95	94	92	82	82	81
14	43.2 - 43.99	80	82	86	90	91	90	91	82	82	81
15	42.4 - 43.19	80	82	85	88	89	88	87	82	82	81
16	41.6 - 42.39	80	82	82	87	88	87	86	82	82	81
17	< 41.6	80	82	82	82	82	82	82	82	82	81

DEMERITS

Type	- Subnormal belly, and roughness - less 3 index points
Quality	- Abnormal fat, colour or texture - Less 10 index points
Trimmable	- The actual weight reduction from the hot carcass weight if the demerit is of farm origin
Ridglings	- Index 67
Emaciated	- Index 80

TARES

Conformation	- Ventre sous la normale et rugosités 3 points de moins à l'indice
Qualité	- Gras, couleur ou texture anormaux 10 points de moins à l'indice
Parage insuffisant	- Poids réel retranché du poids de la carcasse chaude si la tare est attribuée à l'éleveur
Cryptorchides	- Indice de 67
Emacié	- Indice de 80

Carcass weight is affected by two factors – namely dressing percentage and liveweight. Dressing percentage tends to be relatively constant. Any variations are likely due to the amount of gut fill at the time of slaughter, although small differences do exist between some breeds and feeding programs (i.e. pigs on barley-based rations tend to have slightly lower dressing percentages).

Generally, little can be done to alter dressing percentage to any extent so efforts to market pigs in the ideal carcass weight range must be directed toward shipping them at the appropriate liveweight. The ideal weight range may differ slightly from farm to farm depending on facilities, source of breeding stock and feeding program. If a major change in one or more of these factors occurs, the ideal weight range may have to be re-evaluated with respect to financial returns. When feed costs are high it might be economically feasible to market pigs at lower weights as feed conversion ratios become progressively higher as pigs get older. All pigs should be weighed on the day of marketing. In an average size operation a weigh scale will often pay for itself in less than a year through improved indexes that result from the marketing of pigs in the optimum weight range.

Backfat thickness

Backfat thickness is influenced primarily by genetics and nutrition. Generally, environment and health have little direct effect on fatness, although higher health status herds tend to be somewhat fatter as an indirect result of improved growth rate.

Genetic improvement of backfat thickness can be accomplished through selection or crossbreeding. Backfat is a highly heritable trait (i.e. 40%), therefore the selection and use of genetically superior breeding stock will result in measurable improvement. The improvement that will be realized as a result of crossbreeding depends not only on the amount of heterosis expressed by the trait, but also the performance of the breeds chosen as parents. Because of its high heritability and low heterosis effect, backfat thickness is not easily improved by crossbreeding. However, definite breed differences for backfat thickness are known to exist, and the crossing of certain breeds will result in some improvement. The greatest benefit associated with crossbreeding, however, is the improvement in sow productivity.

Diet composition as well as the amount of feed consumed have a direct influence on backfat thickness.

Diet composition refers to the amount of energy, protein, vitamins and minerals in the diet. The energy level of the diet is the major factor affecting fatness, although crude protein levels may also have an effect. Inadequate dietary protein can cause increased backfat deposition, while excess protein has the opposite effect. The economic feasibility of feeding higher protein levels for the purpose of reducing backfat thickness is questionable. The addition of supplemental lysine to the feed has the same effect as excess protein. It decreases feed intake and reduces fat deposition.

The amount of feed a pig will consume depends, to some extent, on its appetite, but is often controlled largely by the producer through ad-lib or restricted feeding. Restricted feeding provides the pig with the necessary energy for maintenance and lean deposition, but restricts the amount available for deposition of fat.

Recent studies at Ridgetown College of Agricultural Technology compared four different methods of feeding:

1. pigs full-fed to market (self-feeders);
2. pigs full-fed to market (floor-fed);
3. pigs with feed restricted to 60 kg (1.5 kg/pig/day), then restricted to market (2.3 kg/pig/day); and,
4. pigs full-fed to 60 kg (floor-fed), then restricted feeding to market (2.3 kg/pig/day) (Table 2).

Table 2. Comparison of the performance of market pigs under different methods of feeding.

	Full-feed (feeders)	Full-feed (floor)	*Restricted/ Restricted	**Full-fed/ Restricted
# of pigs	1951	1868	1530	1757
days on feed	91	98	116	101
feed efficiency	3.10	3.10	2.80	2.90
carcass index	103	105	107	106
net returns	$7,000	$11,000	$12,000	$13,000

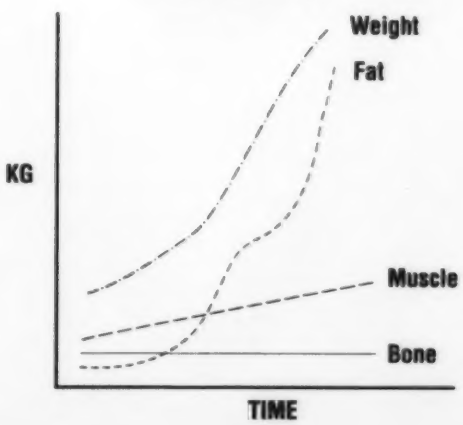
** Restricted to 60 kg (1.5 kg/pig/day), then restricted to market (2.3 kg/pig/day)*

*** Full -fed to 60 kg (floor), then restricted to market (2.3 kg/pig/day)*

J.R. Morris, 1988, Ridgetown College of Agricultural Technology

Carcass index was highest for pigs restricted throughout, followed closely by pigs full-fed, then restricted and pigs fed ad-lib throughout on the floor. Pigs fed ad-lib throughout from self-feeders had the lowest average carcass index although these pigs would likely have indexed the same as the restricted-fed pigs if they had been marketed up to 5 kg lighter. Feed conversion also tended to be slightly improved for pigs with any amount of feed restriction, however, the same pigs had lower average daily gains. An economic analysis of the different methods of feeding showed that full-feeding to 60 kg, followed by restricted feeding resulted in the highest net returns, followed closely by restricted feeding throughout. Net returns for ad lib fed pigs would likely have been higher, however, if they had been marketed earlier. Full-feeding to 60 kg and then restricting intake provides the pig with ample energy when it is young and converting most of the the feed energy to lean, but provides less energy when it begins to lay down much of its as fat (Figure 1).

Figure 1. Relationship of muscle, fat and bone to increasing liveweight and time.



The feasibility of restricted feeding during the finishing phase depends, to a large extent, on input costs. For example, if feed costs are high, restricted feeding may be a viable alternative. Similarly, low-cost buildings would permit restricted feeding since rapid turnover is not essential. On the other hand, high-cost buildings, in order to pay for themselves, would necessitate ad lib feeding in order to increase turn over and make efficient use of space. In addition, ad lib feeding would likely result in higher net returns than restricted feeding when feed costs are low.

Selection for reduced backfat thickness has resulted in pigs that fatten later in life. The result is that modern pigs do not lay down has much fat as early in the finishing phase as their predecessors. Selection has also produced pigs which are more tolerant of high energy levels in their feed. In a study comparing an unselected and a selected strain of pigs, backfat thickness in the selected strain tended to plateau at the higher feed energy levels, whereas it continued to increase in the unselected strain. Genetically lean pigs, therefore, would be expected to produce a lean carcass even on ad-lib feeding, whereas genetically fatter pigs might require some restriction.

Muscle depth

Muscle depth is also influenced largely by genetics and nutrition, although less is know about these influences than with backfat thickness.

Selection for increased muscling has been successful in some breeds (i.e. Pietrain). In Canada, any increase that may have occurred in muscling has been the result of selection for reduced backfat thickness or subjective evaluation. Direct selection for muscling has not been practiced. This can be attributed to the following factors:

1. previous to 1986, producers were not paid on the basis of muscle depth, only the absence of carcass backfat;
2. increased muscling is known to increase the incidence of Porcine Stress Syndrome (PSS), which is costly to the producer in terms of death losses, and to the industry in terms of poorer meat quality (pale, soft, exudative); and
3. breeders have had no objective means of testing for improved muscling. Although loin eye area is highly heritable (50%) and could be improved through selection, appropriate testing procedures for muscling traits have not been available in the past. Ultrasonic equipment is now available which allows determination of muscle and backfat depth in the live animal, however, its greatest use to date has been in research programs. In addition, muscle: bone ratio is not necessarily altered by a change in muscle depth or loin eye area, so measures of these traits may not be highly accurate.

Although muscle depth is now included in the grading formula, its influence is minor. Because of this, a very large difference in muscling would be required to affect carcass index, therefore, the drawbacks of selecting for increased muscling are greater than the potential benefits.

Energy content of the diet also has a marked effect on the deposition of lean tissue (muscling). Bone and muscle grow in a linear fashion with muscle growing considerably faster than bone (Figure 1). Fat growth starts out relatively slowly compared to muscle, but at a certain weight, depending on breed and sex, starts to increase quite quickly. Maximum energy intake up to this weight results in maximum lean tissue deposition, as the young pig is a very efficient converter of feed. Older pigs, on the other hand, are less efficient, since their requirement for maintenance is much greater.

MAXIMIZING CARCASS INDEX

The ideal carcass index is some combination of carcass weight and lean yield. The highest possible index (114) is achieved with pigs that dress out between 75 and 79.99 kg with a yield class of 1 (equal to or greater than 53.6% estimated lean yield). In reality, very few pigs index at 114 – the majority tend to index between 102 and 108.

A pig that dresses out between 70 and 74.9 kg with a yield class of 6 would be given an index of 104 (Table 1). If that same pig had been taken to a heavier weight so that it dressed out between 75 and 79.9 kg it very likely would drop a yield class to 7 because of increased backfat. The resulting index would be 105. Is the extra index point worth the feed needed to put on the extra weight? With low pig prices and high feed costs (Table 3), the benefit of shipping at heavier weights is small ($2.70 per pig)

Table 3. Economics of shipping a pig with a carcass weight of 72.5 kg and a yield class of 6 vs a pig with a carcass weight of 77.5 kg and a yield class of 7.

Scenario # 1 -	**Low Pig Prices High feed Cost**
Market Price:	**$1.32/kg**
G-F Feed Cost:	**$20.74/100 kg**

72.5 kg (carcass wgt.) x $1.32/kg x 1.04 (index) = $99.53
77.5 kg (carcass wgt.) x $1.32/kg x 1.05 (index) = $107.42
$7.89

25 kg of feed to put on extra gain:
Cost $5.19

DIFFERENCE = $7.89 - $5.19 = $2.70

Scenario # 2 -	**High Pig Prices Low feed Cost**
Market Price:	**$2.20/kg**
G-F Feed Cost:	**$15.88/100 kg**

72.5 kg (carcass wgt.) x $2.20/kg x 1.04 (index) = $165.88
77.5 kg (carcass wgt.) x $2.20/kg x 1.05 (index) = $179.03
$13.15

25 kg of feed to put on extra gain:
Cost $3.97

DIFFERENCE = $13.15 - $3.97 = $9.18

particularly in the case of high cost buildings that necessitate rapid turnover of pigs. With high pig prices and lower feed costs, the benefit of shipping at heavier weights is much greater ($9.18 per pig).

Achieving the maximum carcass index is dependent largely on the weight at which pigs are shipped. However, the most economical weight range will differ from farm to farm and will depend on feed cost and feed conversion, facilities and genetics. Time should be taken to determine the ideal weight range for a particular operation.

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